Summary

Watercourse crossings associated with timber harvesting can produce substantial amounts of stream sediment. To reduce the potential for crossing failures and resulting impacts, the California Forest Practice Rules specify that all constructed or reconstructed permanent watercourse crossings must accommodate the estimated 100-year flow, including debris and sediment.

Three methods for making office-based estimates of 100-year recurrence-interval streamflows for ungaged basins are presented: (1) an analytical relationship between storm precipitation, watershed characteristics, and runoff, (2) regional regression equations based on long-term flow records, and (3) flow transference methods that adjust nearby measured discharges for differences in drainage basin size. Watershed area limitations for each method are identified. In general, flow transference methods are preferred for determining 100-year peak discharges in drainage basins where nearby long-term stream gaging station data are available, because local streamflow data are more likely to represent drainage-basin characteristics that determine peak flows than regional regression equations or analytical relationships. The estimated 100-year peak flows are then used to determine a culvert diameter large enough to handle the estimated peak flow and accommodate flood-associated wood and sediment.

Research conducted in northwestern California and the Pacific Northwest shows that culverts fail less often from flood flows alone than from accumulations of wood and sediment that commonly accompany flood flows. Foresters designing watercourse crossings are therefore required to design crossings to handle flood-associated sediment and debris in addition to the estimated peak flows. Several techniques are suggested to decrease the risk of crossing failure from culvert plugging. Other issues related to fish passage are covered elsewhere in the literature and also need to be considered in crossing design for fish-bearing streams.

Culvert diameters determined from estimated peak flows need to be checked in the field by making direct channel cross section measurements. The 3 times (3 X) bankfull stage method is suggested as one approach for field verification, but has only been validated for the rain-dominated North Coast region. Annual high flow line or active channel width measurements are alternatives for smaller or more entrenched channels where bankfull characteristics may be poorly developed.

Examples displayed in the appendix apply the watercourse crossing sizing techniques to a small tributary basin located in the Caspar Creek watershed near Fort Bragg, California. One-hundred year recurrence interval peak discharges are estimated, and wood passage concerns are addressed by sizing the culvert to fit the active channel width. Additionally, the various discharge-estimating techniques for ungaged basins are used to estimate a 10-year peak flow, and these results are compared to actual gaging station data. In this example, the direct flow transference method was found to provide the best estimate of the 10-year recurrence interval event. It is assumed that the techniques giving the best estimates for a 10-year event for this basin would also provide the best estimates of the basin’s 100-year peak flow.